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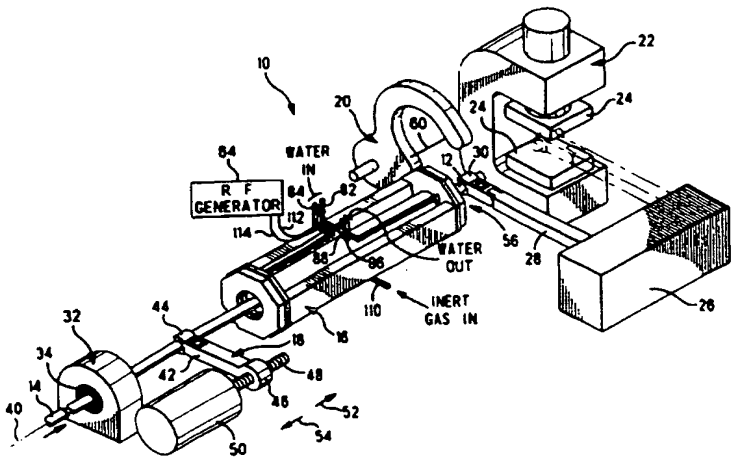
(54) Title: APPARATUS FOR PREPARING A PREFORM SLUG TO BE USED IN A MANUFACTURING OPERATION




(57) Abstract

An apparatus (10) and procedure is disclosed for continuously providing heated preform slugs (12) in their semisolid state for feeding into a forming press (22) without the need for handling individual parts during the initial preparation and heating phases of the process. The apparatus (10) includes a heating unit (16) arranged to heat a bar (14) within a single elongated space (104). A feed mechanism (18) is provided to move the bar (14) through the elongated space (104) to a cutoff mechanism (20) for cutting to length a preform slug (12) having a desired volume. A robotics pick and place unit (26) transports the severed slug (12) to forming dies (24) in an adjacent press (22) for forming into a desired shaped part. A cleaning unit (32) is provided to remove oxides and other contaminants from the outer surface of the bar (14) prior to entering the elongated space (104). An inlet tube (110) is provided for inserting an inert gas into the elongated space (104) during heating to prevent oxidation of the preform slug (12) being heated.

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# APPARATUS FOR PREPARING A PERFORM SLUG TO BE USED IN A MANUFACTURING OPERATION

The present invention relates to the preparation of perform slugs for use in a manufacturing operation, and more particularly to producing a perform slug of a desired volume and heated to a desired temperature so that the slug is in a semisolid state during the manufacturing operation.

So called "semisolid slurry structured material with thixotropic characteristics" having relatively high viscosity so that it can be handled as a soft solid, is commonly used in the industry for forming shaped parts. Such materials are more fully described in United States Patent No. 4,108,643. The material, usually formed in relatively long bars or rods, is cut into appropriate lengths by sawing to create preforms having a desired volume that matches the volume of the finished formed part. Each of the preforms is burnished by tumbling with an abrasive medium to clean it of contaminants, remove burrs from the sawing operation, and to produce a uniform surface condition, and then is subjected to various stages of heating, usually induction heating, to raise its temperature, in steps, until the preform is substantially uniformly semisolid throughout, yet self supporting and free standing. The preform is then transferred to a shaping machine or press having dies for final shaping of the part. An example of such a process and apparatus for carrying out the process is disclosed in United States Patent No. 4,569,218. The '218 patent discloses a rotatable table having pedestals equally spaced about its periphery, each for supporting a preform slug. A series of five induction heaters are spaced along one side of the table in conformance with the spacing of the pedestals. The induction heaters are arranged to move vertically, with respect to the surface of the table, so that by moving

them toward the table each induction heater will surround a respective pedestal and by moving them away therefrom the table and pedestals are free to rotate. Upstream from the induction heaters the preforms are in a vibratory bowl in a loading station and individually placed on respective pedestals. Downstream from the induction heaters a gripper is arranged to remove the heated preforms and place them into a press having a shaping die for final shaping of the part. In operation, the preforms are placed on the pedestals, one by one as the table is indexed to each succeeding position. When the first placed preform reaches the first induction heater, the heaters are lowered into heating position so that the preform is surrounded and heated to a specific first temperature. Then the induction heaters are retracted and the table indexed again so that the first preform is moved to the second induction heater while the second preform is moved to the first induction heater. The induction heaters are then lowered into heating position so that the second preform is heated to the first temperature while the first preform is further heated to a higher second temperature. As this process continues the first preform is finally heated by the last induction heater to the desired temperature and the heaters retracted and the table indexed again. At this point the first preform is removed from its pedestal by the gripper and inserted into the shaping die of the press and formed to the final shape. This process may be continued to produce any desired number of parts. This process and apparatus requires that the individual preforms be cut, cleaned, and deburred prior to placing in the loading station, thereby introducing the usual inefficiencies inherent in handling separate parts. Additionally, since the preforms will oxidize somewhat between the first induction heater and the point where they are

placed in the shaping die, it is desirable to provide an inert environment to minimize this oxidation. However, the disclosed apparatus does not lend itself to such an arrangement short of placing the entire apparatus in an enclosure having a controlled atmosphere. This, of course, would be a cumbersome and expensive solution.

What is needed is a procedure and apparatus for continuously providing heated preform slugs in their semisolid state for feeding into a shaping press without the need for handling individual parts during the initial preparation and heating phases of the process, and for effectively controlling oxidation of the preform slugs prior to insertion into the shaping press.

An apparatus and method are disclosed for preparing a preform slug having a known volume for use in a manufacturing operation. The apparatus includes a heater defining and substantially surrounding an elongated space. The heater is arranged to increase the temperature of the known volume preform slug within the elongated space at a selected rate. A manufacturing unit is disposed adjacent the elongated space and arranged to receive the preform slug and perform the manufacturing operation. A transport mechanism is provided to automatically move the preform slug in a first direction completely through the elongated space in timed relation to the selected rate of temperature increase for heating the preform slug to a desired temperature. The transport mechanism then continues moving the preform slug in the first direction until the slug is outside of the elongated space and then to automatically transport the heated preform slug to the manufacturing unit.

Embodiments of the invention will now be described with reference to the accompanying drawings, in which:

FIGURE 1 is a schematic representation of an apparatus for preparing a preform slug in accordance

with the teachings of the present invention showing the major components and their operational interrelationships;

FIGURES 2, 3, and 4 are front, plan, and end views, respectively, of the heating unit shown in Figure 1;

FIGURE 5 is a cross-sectional view taken along the lines 5-5 of Figure 3;

FIGURE 6 is a cross-sectional view taken along the lines 6-6 of Figure 2; and

FIGURE 7 is a block diagram showing the control functions in accordance with the teachings of the present invention.

There is shown in Figure 1 a schematic representation of an apparatus 10 for preparing a preform slug 12 of a desired volume for forming into a final shaped part. The preform slug is heated and cut from a bar 14 of material prior to forming, as will be explained. The apparatus 10 includes a heating unit 16, a feed mechanism 18 for advancing the bar 14 through the heating unit, a cutoff mechanism 20 for severing the preform slug 12 from the end of the bar 14, and a shaping press 22 having forming dies 24 for receiving the severed preform slug 12 and forming it into a desired shaped part. A robotic unit 26 having a movable arm 28 and gripper 30 is positioned adjacent the cutoff mechanism 20 and the press 22. The robotic unit 26 is arranged to transport the severed preform slug to the press and position it in the forming dies 24. A cleaning unit 32 having rotating brushes 34 is positioned upstream of the heating unit 16 and arranged to clean the outer surface of the bar 14 of oxides and other contaminants just prior to the bar being fed into the heating unit. It will be appreciated that any suitable cleaning unit may be utilized in place of the cleaning unit 32. Such other cleaning units may utilize suitable chemicals in combination with or instead of

rotating brushes, or other abrasive means depending upon the material composition of the bar 14 and the desired effects.

The feed mechanism 18 is arranged to move the bar 14 along its longitudinal axis 40, into and through the interior of the heating unit 16. The feed mechanism includes a feed arm 42 having a gripper 44 at one end thereof that is sized to tightly grip the outer surface of the bar 14. The other end of the feed arm 42 includes a ball nut 46 in threaded engagement with a lead screw 48 that is parallel to the axis 40 and rotatable by means of a servo motor 50. As the servo motor 50 rotates the lead screw 48 the feed arm 42 is made to move back and forth in the direction of the arrows 52 and 54. During feeding, the gripper 44 is opened and the servo motor operated to rotate the lead screw so that the feed arm 42 is moved to a start position away from the heating unit 16. The gripper 44 is then clamped onto the bar 14 and the servo motor 50 operated to rotate the lead screw in the direction of the arrow 52 to move the feed arm 42 toward the heating unit 16 a desired distance, thereby moving the leading end of the bar 14 into the interior of the heating unit 16. As movement of the feed arm 42 continues, the end of the heated bar 14 emerges from the downstream end 56 of the heating unit 16 where a portion of the end is severed from the bar thereby creating the preform slug 12. The amount of movement of the feed arm 42 is very precisely controlled by the servo motor 50 so that a preform slug having a particular length can be made. Since the diameter of the bar 14 is known and the length of the slug is controlled, the volume of the preform slug can be controlled and matched to the desired volume of the finished shaped part, as will be explained below.

The heating unit 16 is arranged to heat the preform slug 12 to a semisolid state prior to severing it from

the bar 14. The cutoff mechanism 20, which includes a cutoff wire or blade 60, is made to pass the wire or blade through the bar 14 thereby severing the preform slug 12.

As shown in Figure 1 the heating unit 16 is RF driven for induction heating of the bar 14 by means of an RF generator 64. As best seen in Figures 2, 3, and 5, the heating unit 16 includes an induction heating coil 66 that is helically wound and in engagement with and supported by the inside surface 68 of an electrically insulating tube 70. The two ends of the tube 70 are supported by a pair of insulating plates 72 each of which has a hole 74 formed therethrough that closely receives the outside diameter of the tube 70. A pair of longitudinal structural members 76 extend between the two plates 72 and are rigidly attached to the plates by means of screws 78. As best seen in Figure 4, the two plates 72 include relatively flat bearing surfaces 80 for attachment to a suitable frame. The heating coil 66 is made of metal tubing which, in the present example, is copper alloy and has a square cross section, however, it may be round or any other suitable shape. The outside ends of the tubing are folded back toward the center of the coil 66, as best seen in Figures 2 and 3, and terminate in two upright ends 82 and 84 which serve as inlets for cooling water and electrical connecting points for the RF current. A pair of water outlet ports 86 and 88 extend upwardly from the approximate center of the coil 66 in communication with the interior of the coil tubing so that cooling water pumped into the inlet ends 82 and 84 will circulate through the entire length of the coil 66 and exit through the outlet ports. A pair of intermediate plates 90 and a pair of outer plates 92 are attached to the insulating plates 72 by means of screws 94 and nuts 96, as shown in Figures 3 and 4. The plates

90 and 92 are made of a fire board such as phenolic or other suitable heat resistant material. A ceramic tube 100 is disposed within the coil 66 extending through the two insulating plates 72 and into holes 102 in the plates 90, as best seen in Figure 5. The interior of the ceramic tube 100 defines a single elongated space 104 that is substantially surrounded by the coil. The two outer plates 92 have holes 106 having diameters that are equal to or slightly smaller than the inside diameter of the ceramic tube, thereby holding the ceramic tube captive between the plates 92 and permitting through access to the elongated space 104. An inlet tube 110 extends through the outer tube 70, between two of the coils of the coil 66, and through the wall of the ceramic tube 100 so that the inlet tube is in communication with the elongated space 104. The inlet tube is positioned in the approximate longitudinal centers of the coil 66 and ceramic tube 100. During operation inert gas, such as argon, is pumped into the inlet tube 110 and allowed to substantially fill the elongated space so that it flows out of the two opposite ends of the ceramic tube to minimize oxidation of the bar 14 being heated therein. This is important because an oxide layer on the outside surface of the preform slug can adversely affect the surface finish of the final formed part.

As shown in Figure 1, the RF generator 64 is interconnected to the coil 66 by means of the conductors 112 and 114 which are bolted directly to the outer surfaces of the tube ends 82 and 84. The RF generator includes a power supply that may range in size from 5 to 550 KW and may operate at frequencies from 60 to 400,000 hertz. The particular power and frequency are selected based upon the size and particular composition of the bar 14. For example, the power requirements for aluminum alloy may range from 0.25 to 1.0 KW per pound

of aluminum per hour of heating time. However, higher efficiencies are expected because, unlike prior art procedures, the preform slug remains within the induction coil until it is fully heated. It is desirable to increase the temperature of the preform slug prior to severing from the bar 14 to about 1075 degrees fahrenheit where the slug is in a fractional solid or semisolid state, about 70 percent solid and 30 percent liquid. This is important because the slug must be firm enough to be handled by the gripper 30 without deforming, yet soft enough to easily be formed by the press 22.

In operation, a bar 14 of aluminum alloy is fed into the cleaning unit 32 and engaged by the gripper 44 of the feed mechanism 18. Under computer control, the RF generator supplies current to the coil 66, about 370 amperes in the present example, and the servo motor 50 is operated to begin feeding the bar 14, in the direction of the arrow 52, into the elongated space 104 of the heating unit 16. As the end of the bar 14 enters the space 104 it is subjected to the RF energy and begins to increase in temperature. Feeding movement of the feed arm 42 continues until the end of the bar 14 has moved about 1.5 to about 2.5 inches. The feed mechanism 18, again under computer control, then stops feeding for a period of time, about seven to nine seconds in the present example, allowing the end of the bar to reach a first equilibrium temperature. Then feeding is resumed for another 1.5 to 2.5 inches and again stopped for a similar interval of time so that the end of the bar can reach a higher second equilibrium temperature while the portion of the bar 14 that has just entered into the elongated space 104 is raised to the first equilibrium temperature. As this alternating feeding and stopping continues the bar 14 is moved further into the elongated space 104 where the

temperature of the end of the bar is progressively increased until it reaches the desired temperature of between about 1020 and about 1150 degrees fahrenheit. At this point the end of the bar 14 is in the desired semisolid state and is in a known position adjacent the downstream end 56 of the heating unit 16. The feed mechanism 18 is then operated to advance the bar 14 a precise desired distance and the cutoff mechanism 20 actuated to sever a first preform slug 12 from the bar 14. The precise distance fed is chosen to produce a preform slug having a specific volume that is required to produce the finished part in the forming dies 24. The severed preform slug 12 is then lightly griped by the robotic gripper 30 and transported to the forming dies 24 in the press 22. The preform slug 12 is then formed into the final shaped part in the usual manner. After the desired time period has elapsed the feed mechanism again feeds the bar 14 another precise distance and a second preform slug 12 is severed from the bar 14 by the cutoff mechanism 20 and transported to the forming dies 24 by the robotic gripper 30. As the bar 14 is fed intermittently through the elongated space 104, adjacent portions of the bar are at succeeding higher temperatures beginning from the upstream end toward the downstream end 56, each portion being a preform slug prior to severing, so that each portion is gradually increased in temperature until it reaches the desired temperature of between about 1020 and about 1150 degrees fahrenheit concurrently with reaching the downstream end 56. This process continues until the upstream end of the bar 14 is no longer within the movement range of the feed mechanism 18. At this point a second bar 14 is fed into the cleaning unit 32 and engaged by the gripper 44 of the feed mechanism 18 with the downstream end of the second bar in abutting engagement with the upstream end of the first bar.

Under computer control the feed mechanism 18 continues its alternating feeding and stopping, and additional preform slugs are, one at a time, severed from the downstream end of the first bar 14 and placed in the forming dies 24 for forming by the press 22, as described above. When the abutting ends of the first and second bars 14 reach the downstream end 56 of the heating unit 16, the end of the first bar may have to be discarded if it is too short. While there are economies in utilizing relatively long bars 14, about ten feet in the present example, shorter bars 14 may be advantageously utilized. Bars having a length equal to the severed length of the preform slugs may be utilized and would have the additional advantage that the cutoff mechanism would not be needed, however, they would have some of the disadvantages of the prior art apparatus in that they would have to be individually cut to length, deburred, and cleaned. Optionally, an inert gas such as argon may be pumped into the elongated space 104 through the inlet tube 110 to flood the space around the bar 14 as it is being heated. Excess gas will simply flow out of the two ends of the ceramic tube 100. Importantly, the gas will help to prevent harmful oxidation of the outer surface of the bar 14 while the bar is being heated within the elongated space 104.

There is shown in Figure 7 a block diagram of the major functions of the apparatus 10 including a computer 120 having an input output terminal 122 for operator control of the system in the usual manner. The computer is interconnected to the RF generator 64, serve motor and gripper of the feed mechanism 18, motor for the rotating brushes of the cleaning unit 34, cutoff mechanism 20, robotic unit 26, and forming press 22. Each is operated by the computer in the desired sequence under program control, in the usual manner, for automatically and continuously preparing preform slugs

of a specific volume in a specific semisolid state and forming the slugs to a desired shaped final part. A temperature sensor array 124 may be arranged to sense the temperature of the preform slugs 12 as they are being heated within the elongated space 104 and feed this information back to the computer so that current flow through the coil 66 and feed parameters can be adjusted as required.

It will be appreciated by those skilled in the art that, while the heating unit 16 in the present example is an RF heater, a resistance, radiant, or other type heater may be used in the practice of the teachings of the present invention. Further, the coil 66 may be several discrete coils that are closely adjacent and collectively are substantially surrounding the elongated space 104. While the longitudinal axis of the apparatus 10 is horizontally disposed, in the present example, it will be understood that the axis may be arranged in any position, including vertically.

An important advantage of the present invention is that preform slugs can be progressively heated to a desired temperature where the slug is in a semisolid state without moving the slug through several separate heating stations. The single heating station of the present invention permits the economical use of an inert gas to shroud and prevent oxidation of the outer surface of the preform slugs. Another important advantage is that the preform slug can be automatically cut off of a relatively long bar after it is heated to its semisolid state. This eliminates the need to handle loose parts and the required separate cleaning and deburring operation, thereby providing a more efficient and economical manufacturing operation. Further, power requirements will be reduced due to expected higher efficiencies of the system.

CLAIMS:

1. Apparatus (10) for preparing a preform slug (12) having a known volume for use in a manufacturing operation characterized by: a heater (16) defining and substantially surrounding a single elongated space (104), said heater (16) arranged to increase the temperature of said known volume preform slug (12) within said elongated space (104) at a selected rate until said preform slug (12) is in a desired semisold state; a manufacturing unit (22,24) adjacent said elongated space (104) and arranged to receive said preform slug (12) and perform said manufacturing operation therewith; and a transport mechanism (18,26) arranged to move said preform slug (12) in a first direction (52) completely through said elongated space (104) in timed relation to said selected rate of temperature increase for heating said preform slug (12) to a desired temperature, then to continue moving said preform slug (12) in said first direction (52) until outside of said elongated space (104) in timed relation to said selected rate of temperature increase for heating said preform slug (12) to a desired temperature, then to continue moving said preform slug (12) in said first direction (52) until outside of said elongated space (104), and then to transport said heated preform slug (12) to said manufacturing unit (22, 24).

2. The apparatus (10) according to claim 1 wherein said manufacturing unit is a forming die (24) for producing a desired shaped part from said preform slug (12) heated to said semisolid state, said apparatus (10) characterized in that said perform slug (12) is an aluminum slug and said heater (16) is arranged to raise the temperature of said aluminum slug (12) to a temperature of between about 1020 and about 1150 degrees fahrenheit.

3. The apparatus (10) according to claim 2 characterized in that said heater (16) is arranged to raise the temperature of said preform slug (12) until said preform slug (12) is in a semisolid state of about 70 percent solid and 30 percent liquid.

4. The apparatus (10) according to claim 1 characterized is that said perform slug (12) is a portion of a relatively long bar (14) of material, said apparatus (10) including a cutoff mechanism (20) positioned between said second end (56) and said manufacturing unit (22, 24) arranged to automatically sever said perform slug (12) from said long bar (14) so that said perform slug (12) is of a desired known volume.

5. The apparatus (10) according to claim 4 characterized in that said cutoff mechanism (20) includes a steel wire (60) arranged to sever said portion from said long bar (14) and wherein said preform slug (12) is heated to a temperature sufficient to render said perform slug (12) severable by said steel wire (60).

6. The apparatus (10) according to claim 1 characterized in that said transport mechanism (18, 26) effects movement of said perform slug (12) through said elongated space (104) incrementally, said incremental movement consisting of alternating lengths of movement and durations of time of non-movement arranged so that said preform slug (12) is at said desired temperature when it reaches said second end (56).

7. The apparatus (10) according to claim 1 characterized by a ceramic tube (100) disposed between said elongated space (104) and said heater (16), one end thereof terminating at said first end and the other end thereof terminating at said second end (56).

8. The apparatus (10) according to claim 1 characterized by a cleaning unit (32) disposed adjacent

said first end and arranged to remove oxide and other contaminants from said preform slug (12) prior to said slug (12) entering into said elongated space (104).

9. The apparatus (10) according to claim 8 characterized in that said cleaning unit (32) is a wire brush (34) arranged in rubbing engagement with said preform slug (12) so that as said transport mechanism (18, 26) moves said preform slug (12) into said elongated space (104), said preform slug (12) first moves past said wire brush (34).

10. The apparatus (10) according to claim 1 characterized by an inlet tube (110) in communication with said elongated space (104), for inserting an inert gas thereinto during heating of said perform slug (12).

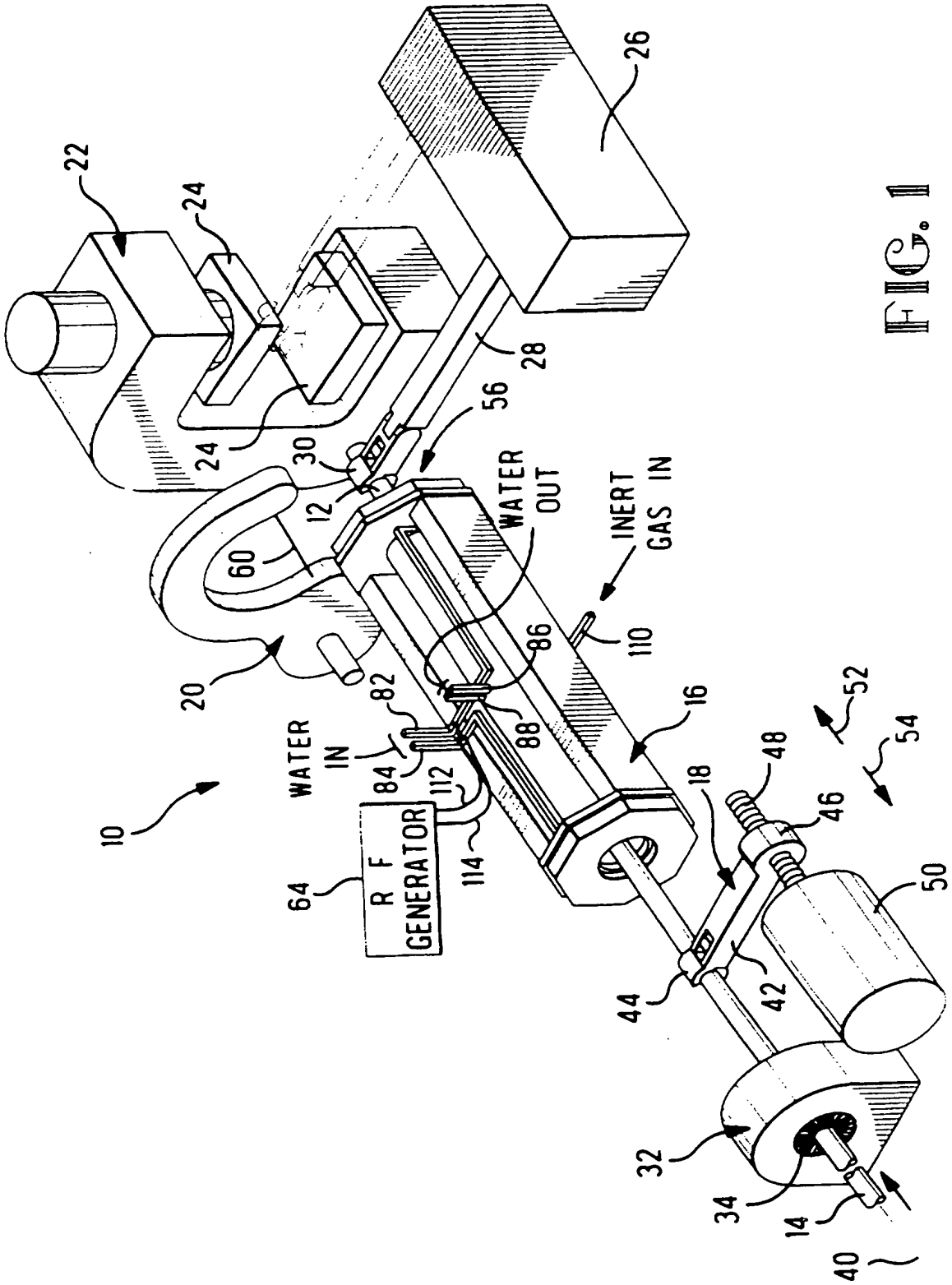
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FIG. 1

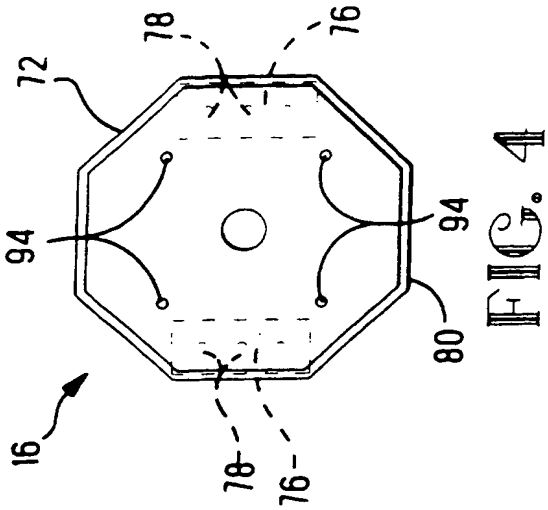



FIG. 4

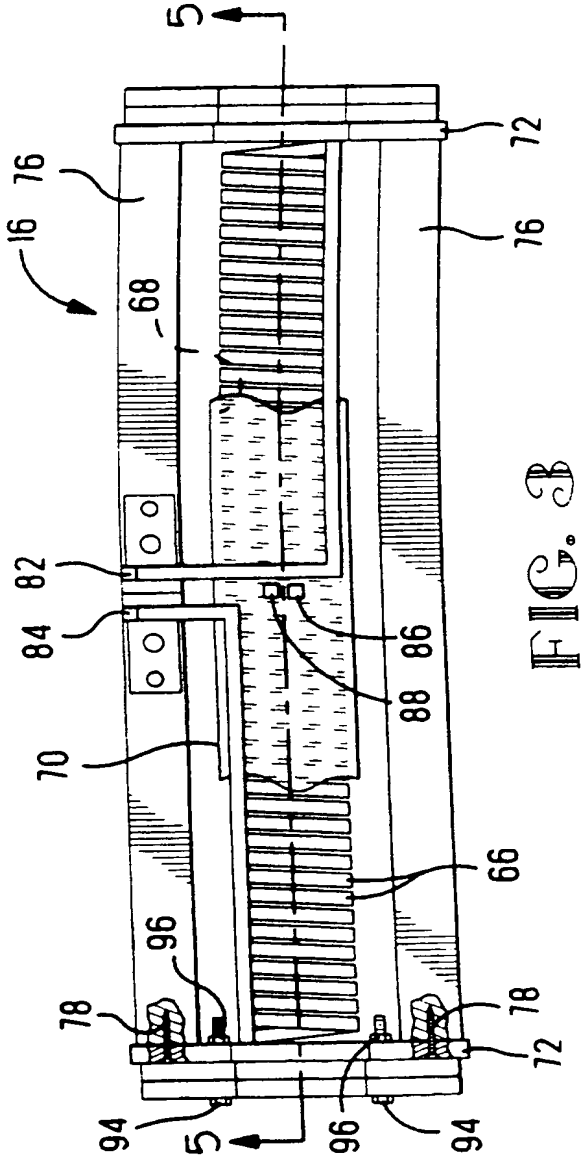



FIG. 3

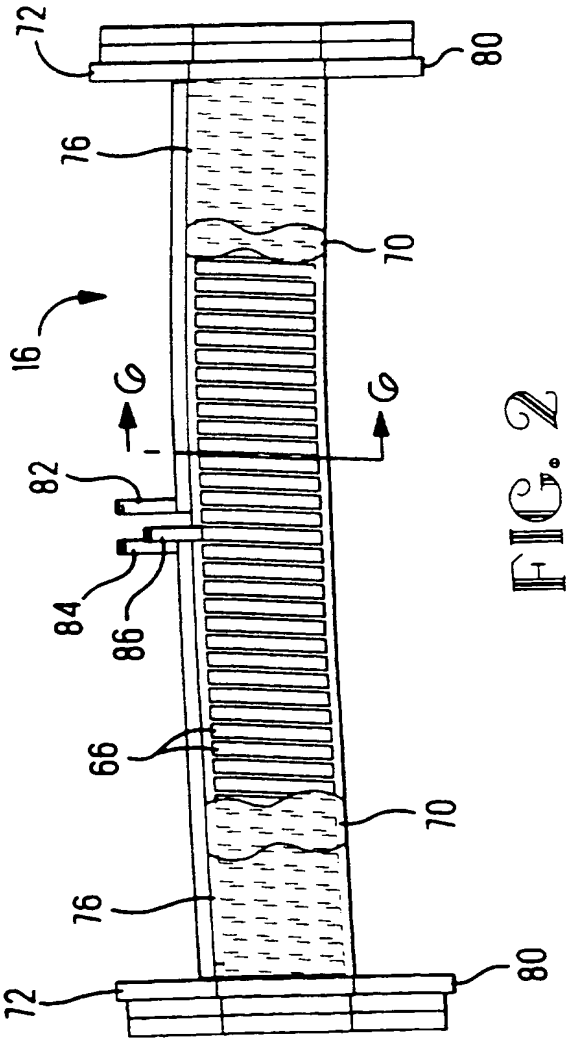
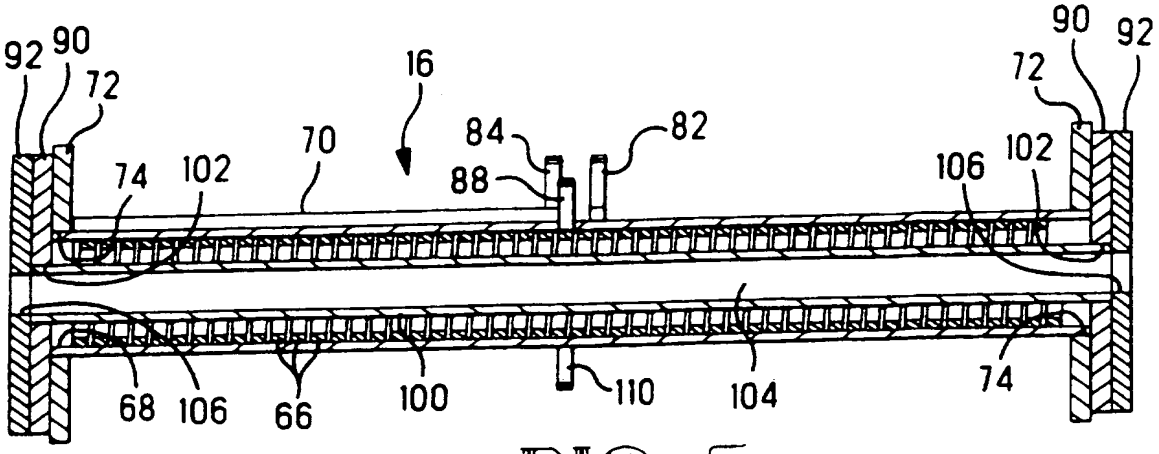



FIG. 2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90
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16
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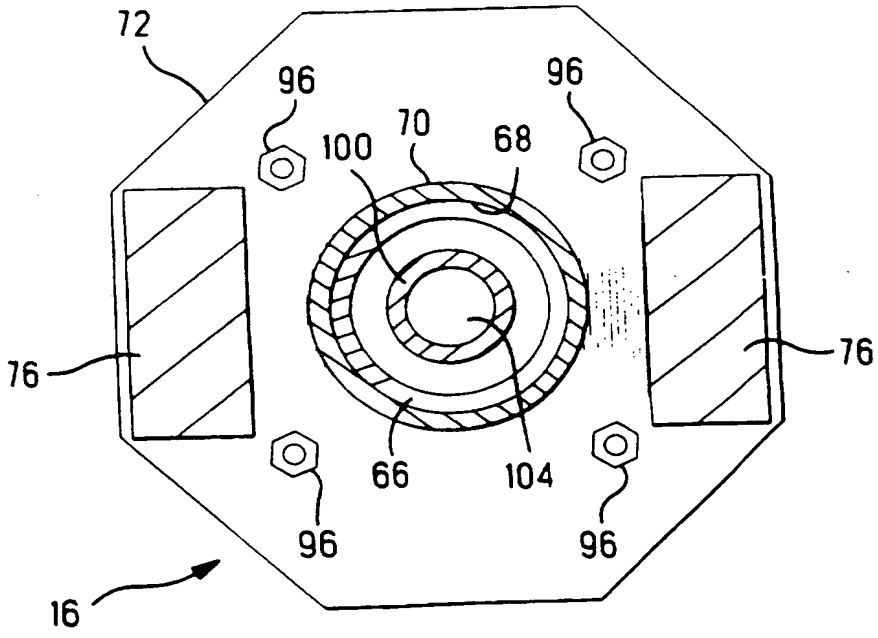
110
104
74

FIG. 5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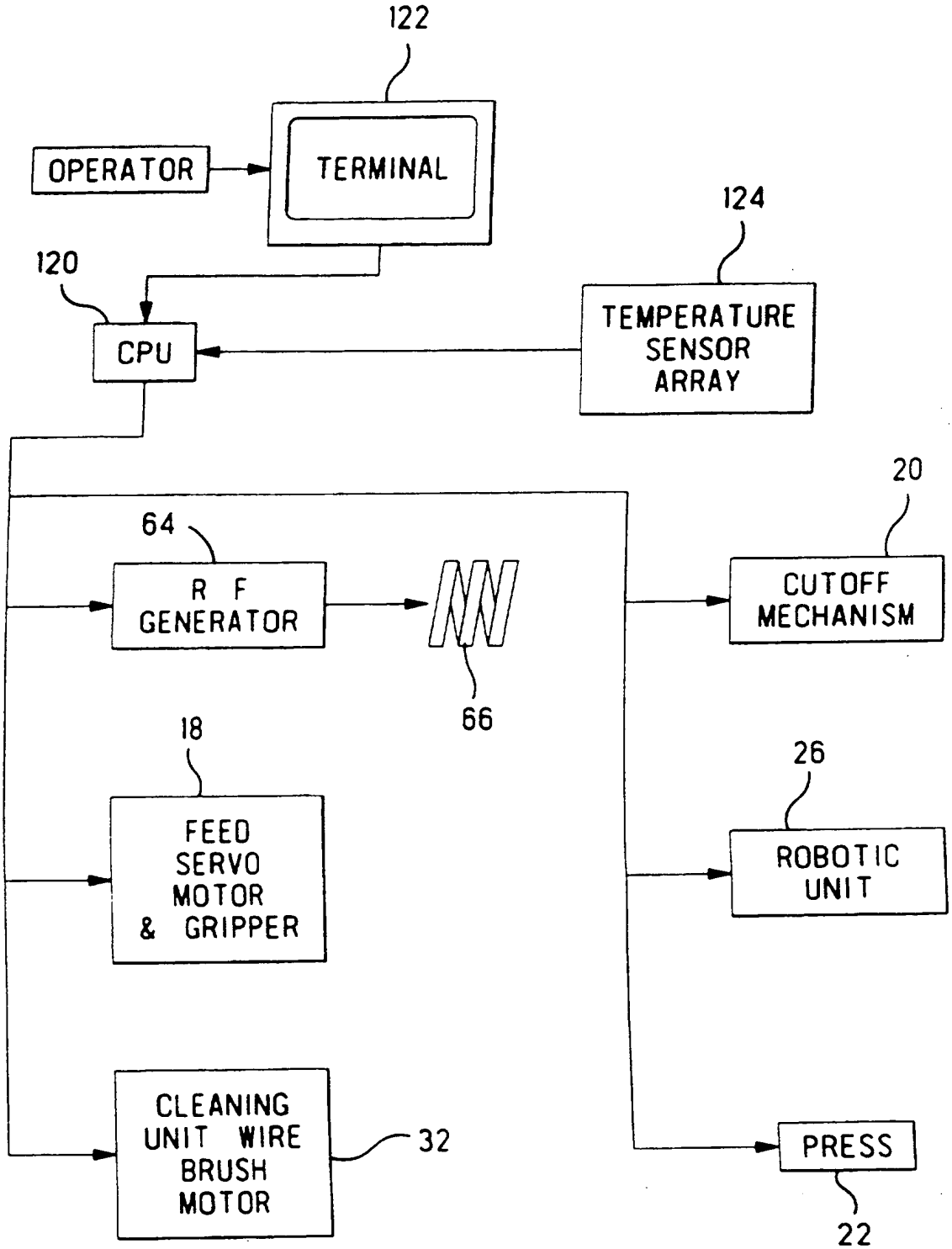
96
16

FIG. 6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64
R F GENERATOR
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CUTOFF MECHANISM
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26
FEED SERVO MOTOR & GRIPPER
ROBOTIC UNIT
CLEANING UNIT WIRE BRUSH MOTOR
32
PRESS
22

FIG. 7

# INTERNATIONAL SEARCH REPORT

Inte nal Application No
PCT/US 96/14808

A. CLASSIFICATION OF SUBJECT MATTER
IPC 6 B21J1/06 B21J17/00

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)
IPC 6 B21J B26D

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practical, search terms used)

C. DOCUMENTS CONSIDERED TO BE RELEVANT

| Category * | Citation of document, with indication, where appropriate, of the relevant passages | Relevant to claim No. |
|---|---|---|
| X | EP,A,0 518 815 (ALUSUISSE LONZA SERVICES AG) 16 December 1992<br>see column 2, line 22 - column 3, line 23;<br>claims 1,6-10 | 1-3,6 |
| A | US,A,4 569 218 (BAKER ROBERT L ET AL) 11 February 1986<br>cited in the application<br>see column 3, line 9 - column 4, line 68;<br>claims 1,2,11; figures | 1,6 |
| P,X | DE,A,195 08 919 (BUEHLER AG) 23 November 1995<br>see abstract; claim 1<br>see column 3, line 24 - line 29 | 1,6 |

-/--

[X] Further documents are listed in the continuation of box C.

[X] Patent family members are listed in annex.

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"O" document referring to an oral disclosure, use, exhibition or other means

"P" document published prior to the international filing date but later than the priority date claimed

"T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention

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"Y" document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art.

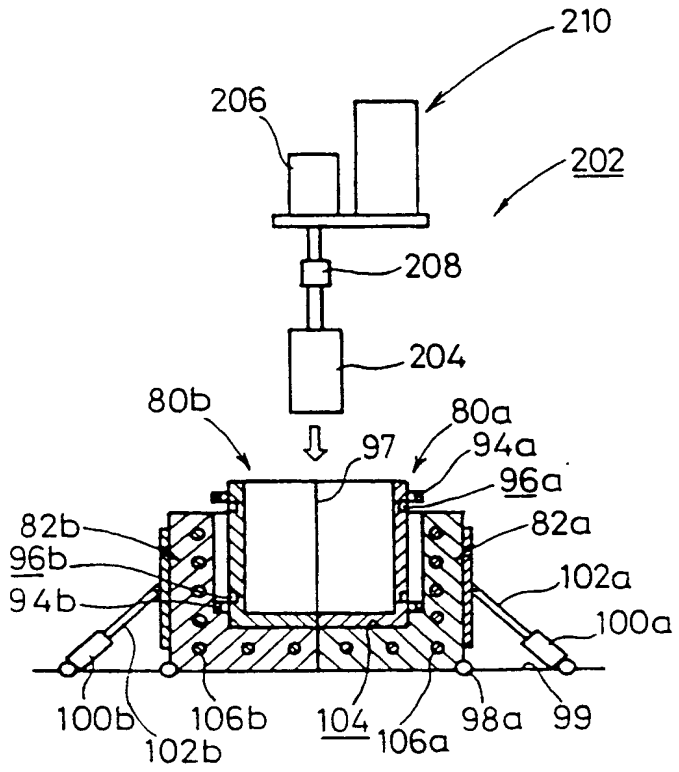
"&" document member of the same patent family

| Date of the actual completion of the international search | Date of mailing of the international search report |
|---|---|
| 20 November 1996 | 02.12.96 |

| Name and mailing address of the ISA | Authorized officer |
|---|---|
| European Patent Office, P.B. 5818 Patentlaan 2<br>NL - 2280 HV Rijswijk<br>Tel. ( + 31-70) 340-2040, Tx. 31 651 epo nl,<br>Fax ( + 31-70) 340-3016 | Barrow, J |

Form PCT/ISA/210 (second sheet) (July 1992)

FIG.17


210
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106b
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106a
98a
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102b

FIG.18

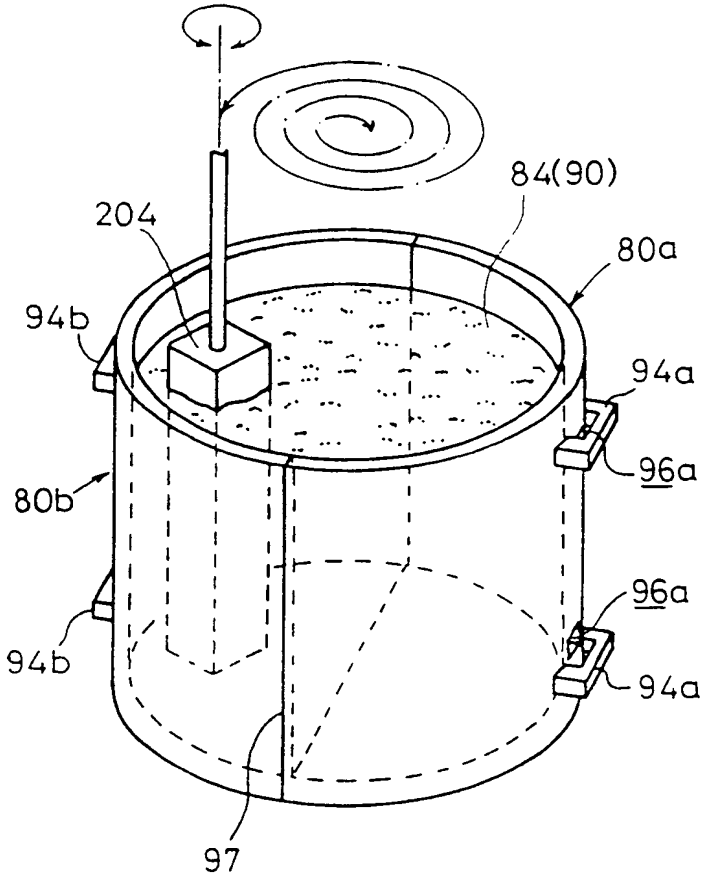


FIG.19

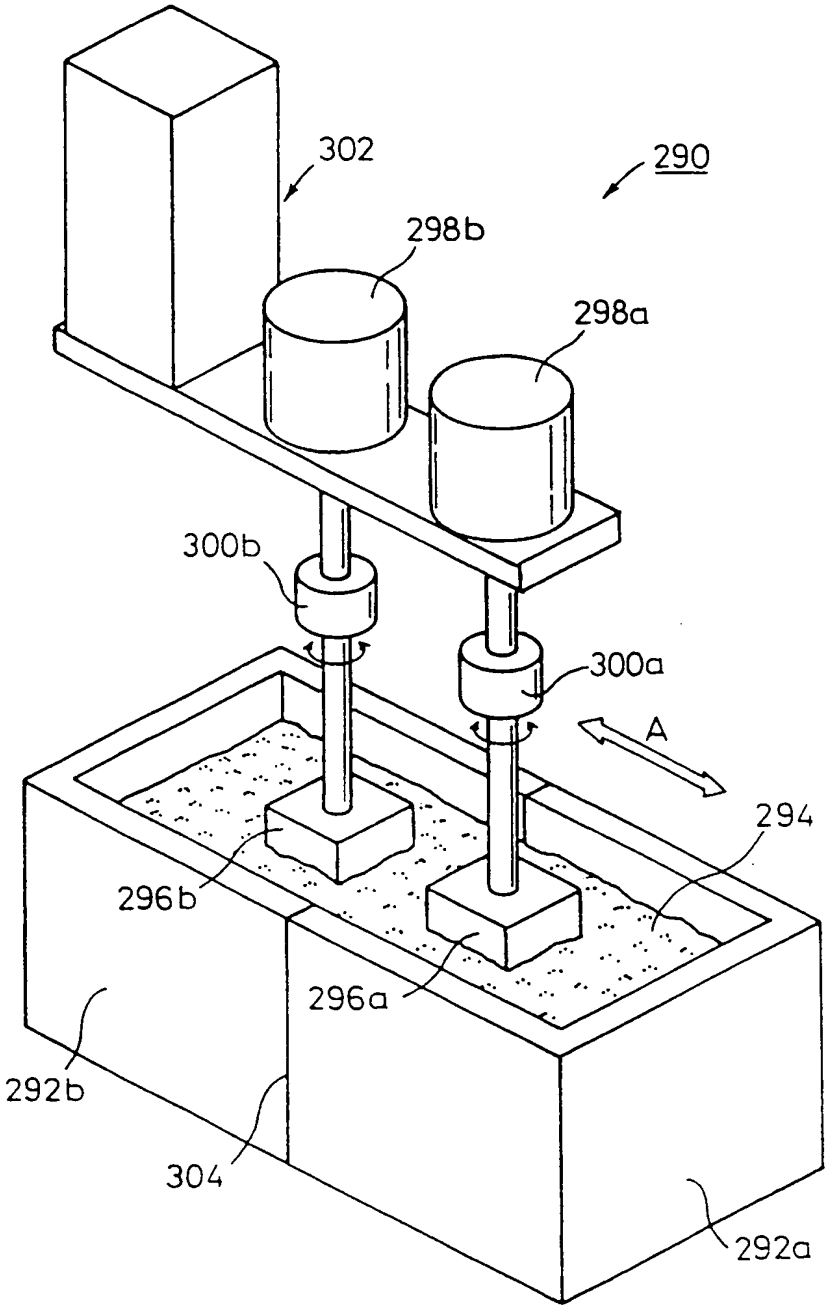


FIG.20

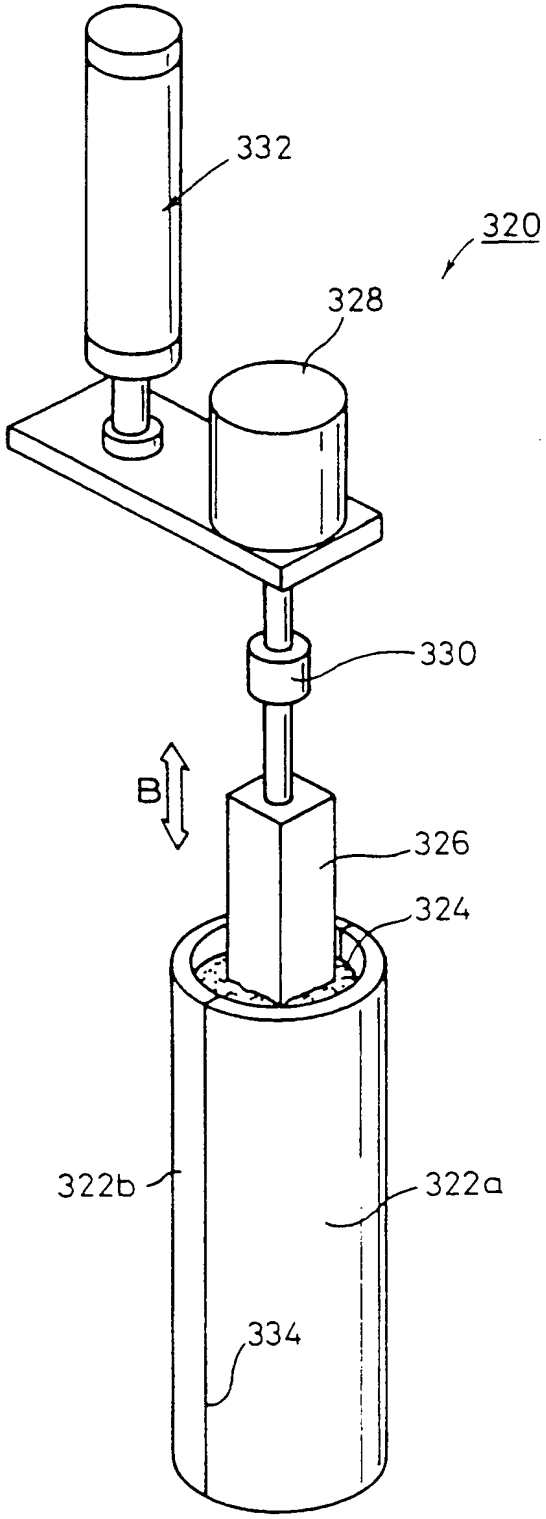


FIG. 21

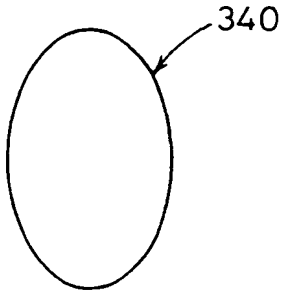



FIG. 22

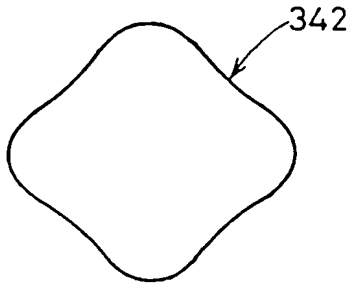


FIG. 23

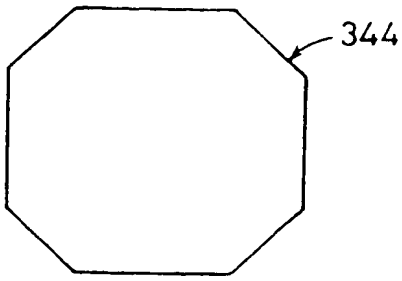



FIG. 24

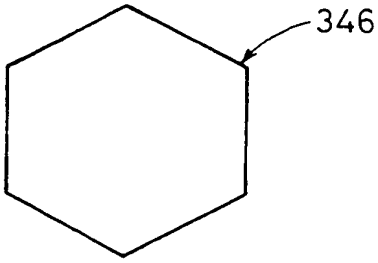



FIG. 25

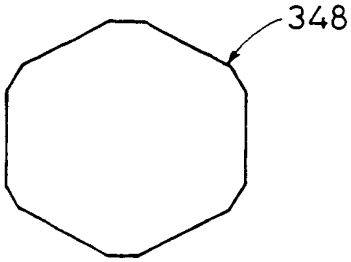
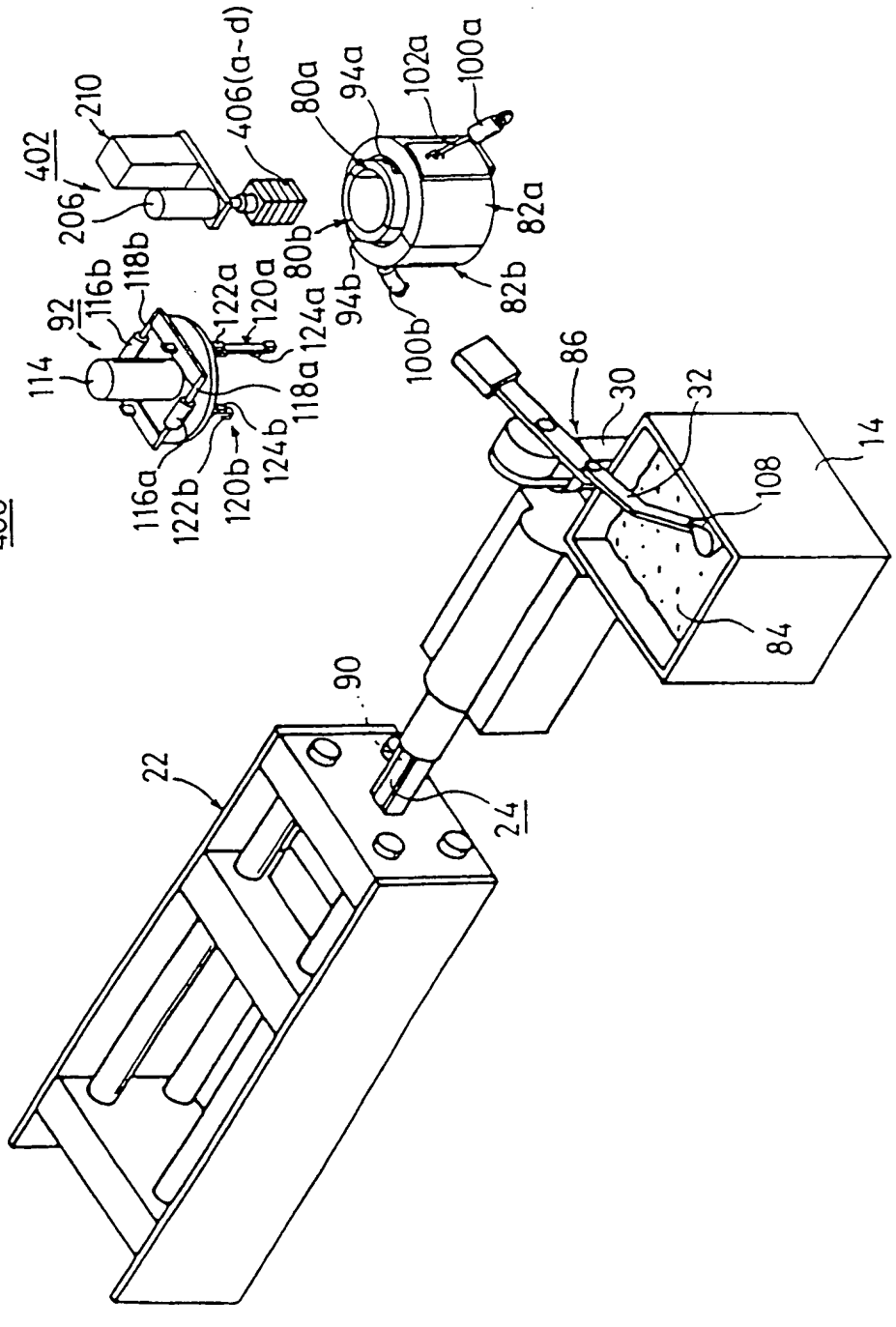


FIG.26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116b
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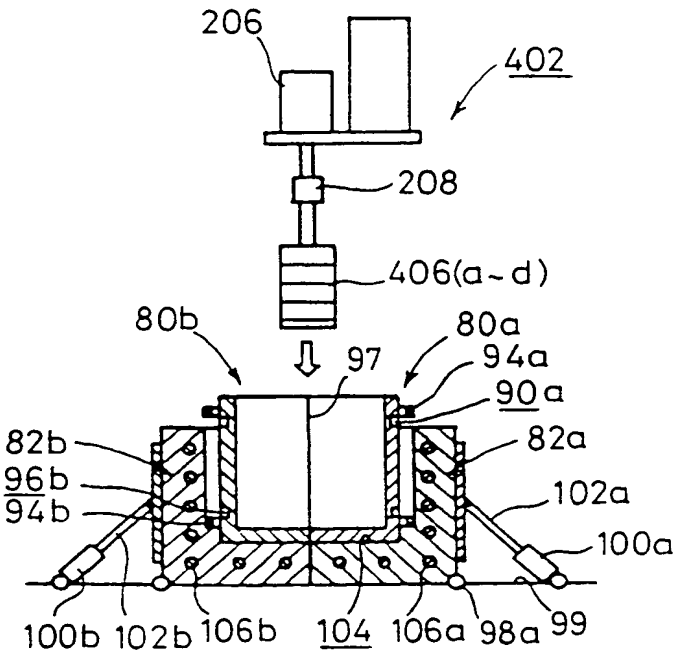
FIG.27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406(a~d)
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106b
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106a
98a
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FIG.28

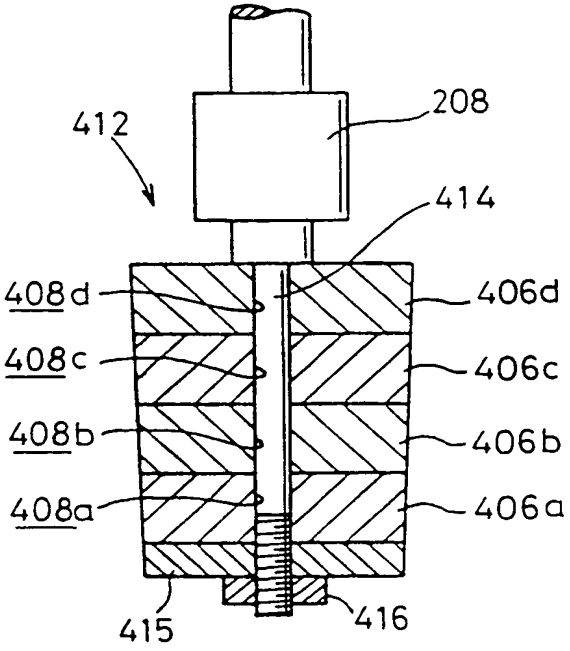
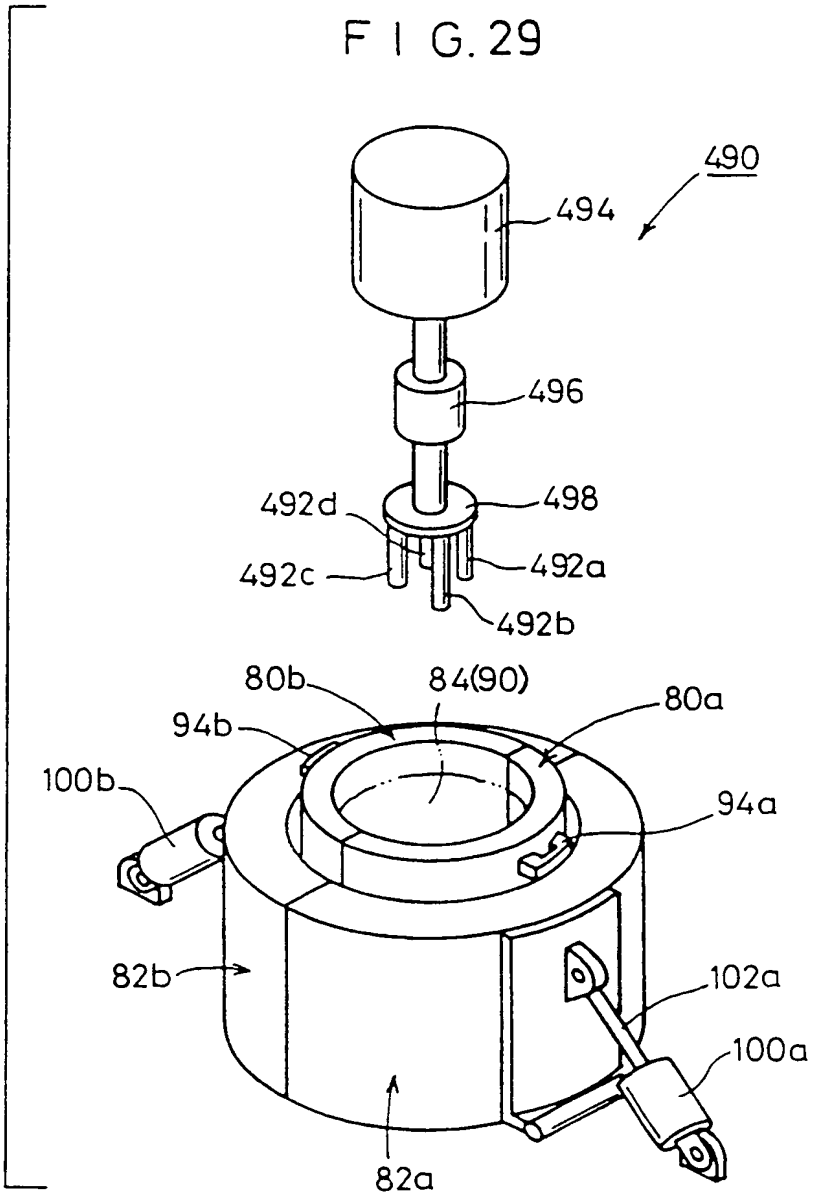


FIG. 29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492d
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82b
102a
100a
82a

FIG.30

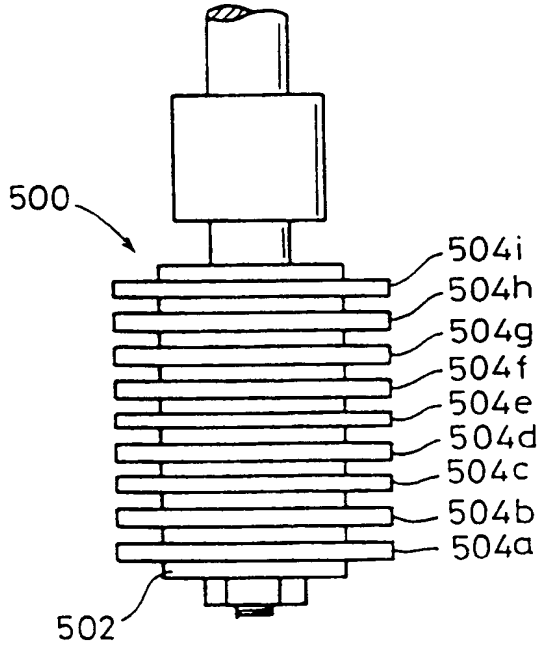
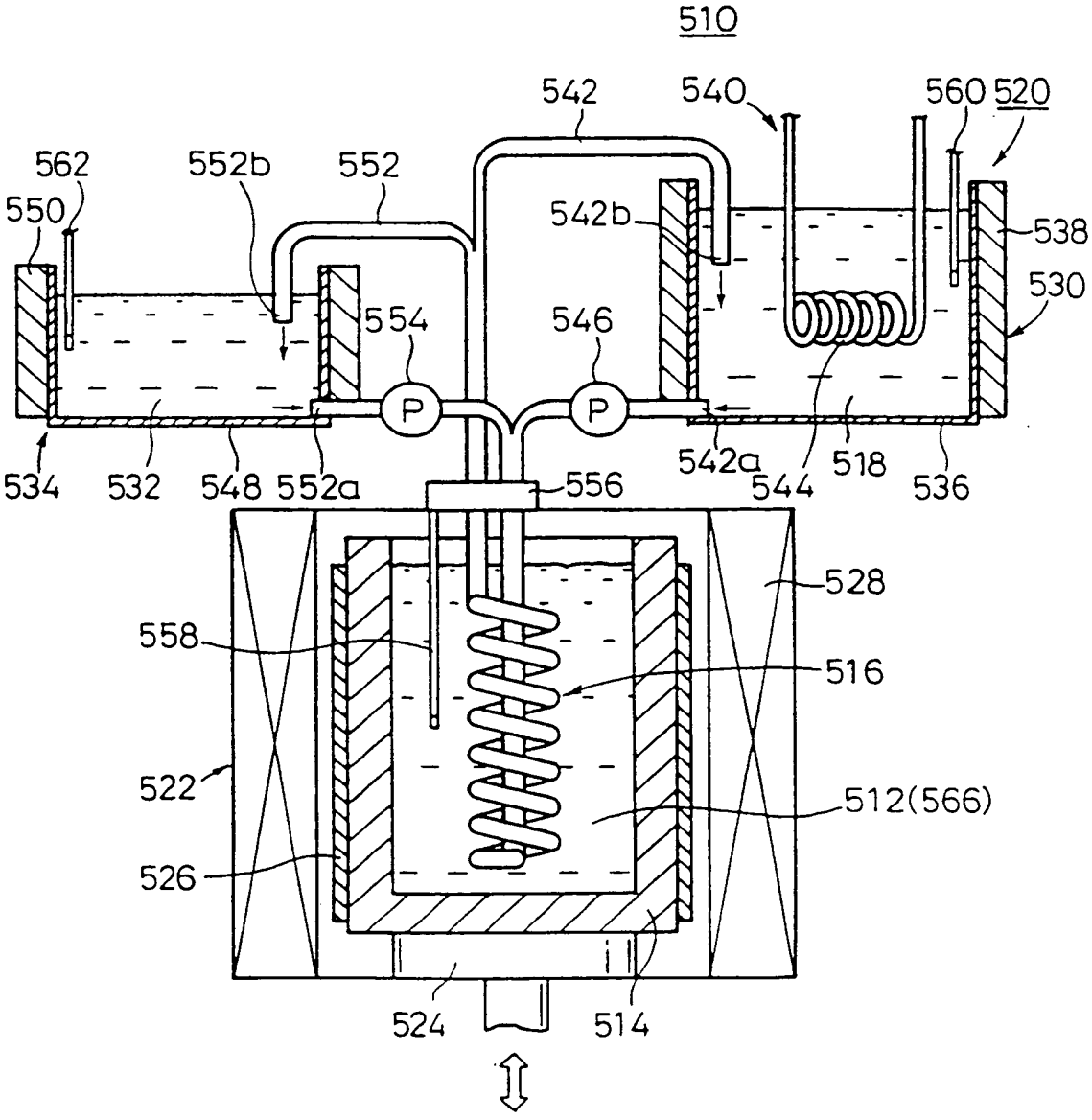


FIG.31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542b
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530
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P
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542a
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512(566)
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514

FIG.32

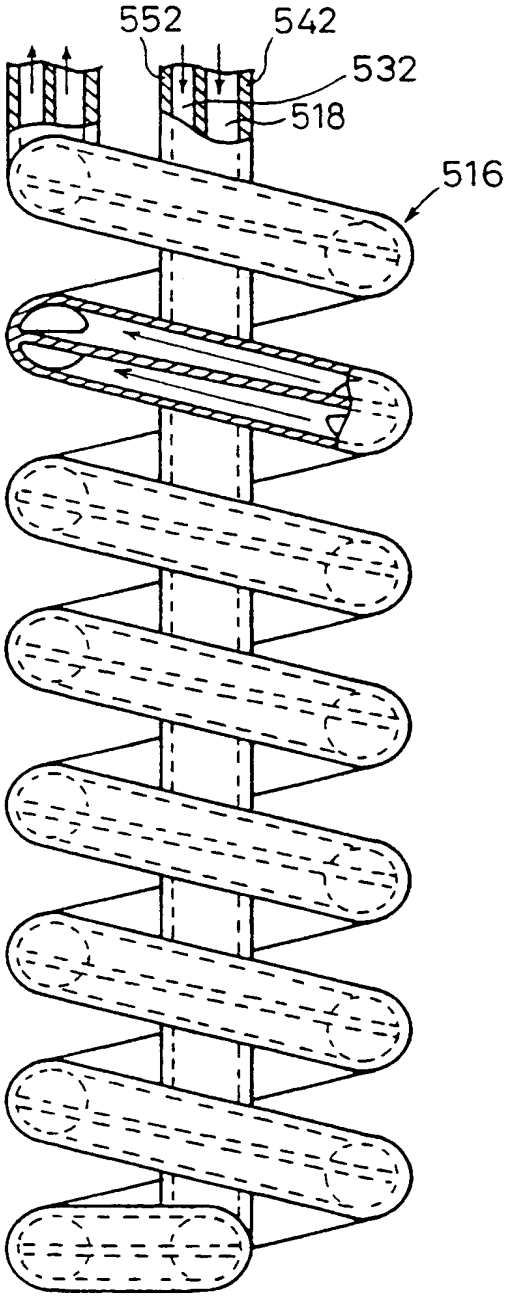


FIG.33D

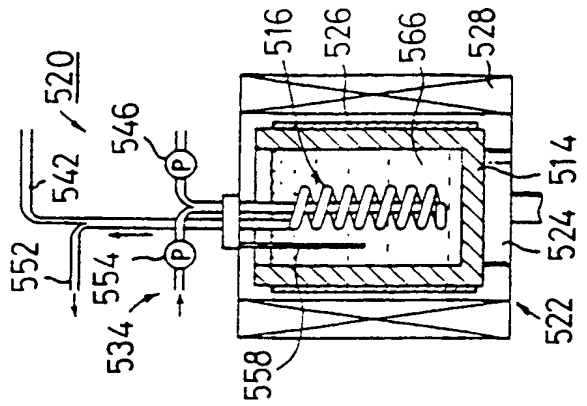



FIG.33C

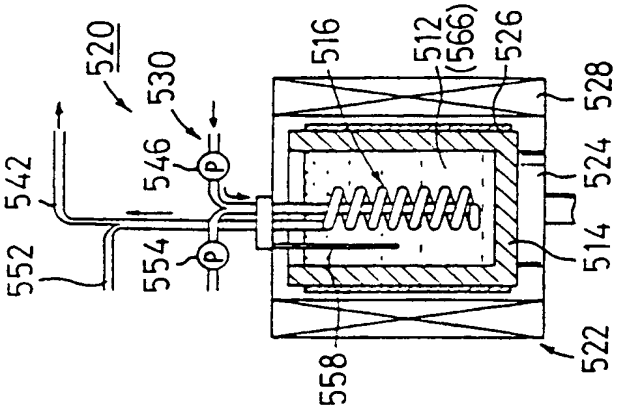



FIG.33B

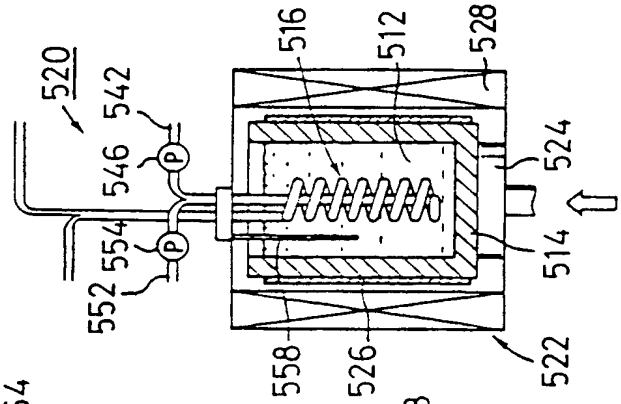
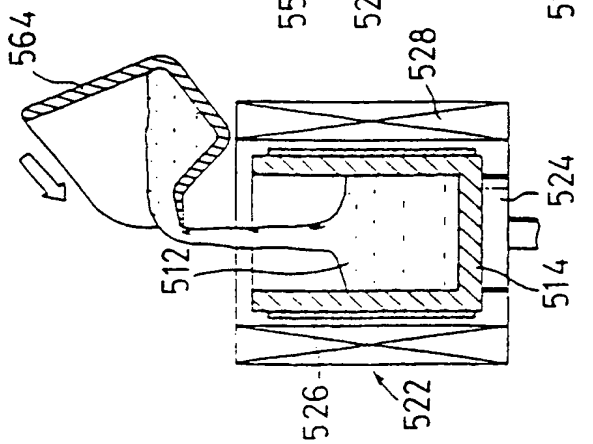



FIG.33A



# INTERNATIONAL SEARCH REPORT

International application No.
PCT/JP99/00163

A. CLASSIFICATION OF SUBJECT MATTER
Int.Cl[6] B22D1/00, 17/30, C22C1/02

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)
Int.Cl[6] B22D1/00, 17/30, C22C1/02, C22B9/02, F27B14/10

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched
Jitsuyo Shinan Koho 1926-1996 Toroku Jitsuyo Shinan Koho 1994-1999
Kokai Jitsuyo Shinan Koho 1971-1999 Jitsuyo Shinan Toroku Koho 1996-1999

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)

C. DOCUMENTS CONSIDERED TO BE RELEVANT

| Category* | Citation of document, with indication, where appropriate, of the relevant passages | Relevant to claim No. |
|---|---|---|
| Y<br>A | JP, 3-162533, A (The Furukawa Electric Co., Ltd.), 12 July, 1991 (12. 07. 91), Page 1, left column, lines 5 to 14 ; page 2, lower left column, line 3 to lower right column, line 13 ; Fig. 1 (Family: none) | 1, 2, 5-16, 19, 20, 27<br>3, 4, 17, 18, 21-26, 28-30 |
| Y<br>A | JP, 2-290931, A (Suzuki Motor Co., Ltd.), 30 November, 1990 (30. 11. 90), Page 2, upper right column, line 8 to lower right column, line 7 ; Fig. 2 (Family: none) | 1, 2, 5-16, 19, 20, 27<br>3, 4, 17, 18, 21-26 |
| Y | JP, 62-130234, A (Director General, Agency of Industrial Science and Technology), 12 June, 1987 (12. 06. 87), Page 3, upper left column, lines 6 to 12 ; Fig. 1 (Family: none) | 5, 6<br>10, 15 |
| Y | JP, 7-223047, A (Hitachi Cable,Ltd.), 22 August, 1995 (22. 08. 95), Column 1, lines 2 to 10 ; Fig. 1 (Family: none) | 2, 11-14 |

[x] Further documents are listed in the continuation of Box C. [ ] See patent family annex.

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| Date of the actual completion of the international search | Date of mailing of the international search report |
|---|---|
| 10 March, 1999 (10. 03. 99) | 23 March, 1999 (23. 03. 99) |
| Name and mailing address of the ISA<br>Japanese Patent Office | Authorized officer |
| Facsimile No. | Telephone No. |

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# INTERNATIONAL SEARCH REPORT

International application No.
PCT/JP99/00163

C (Continuation). DOCUMENTS CONSIDERED TO BE RELEVANT

| Category* | Citation of document, with indication, where appropriate, of the relevant passages | Relevant to claim No. |
|---|---|---|
| Y | JP, 4-88135, A (Rheo-Technology Ltd.), 23 March, 1992 (23. 03. 92), | 8, 16, 19 |
| A | Page 2, lower left column, line 6 to lower right column, line 14 ; Figs. 1 to 3 (Family: none) | 18 |
| Y | JP, 7-185778, A (Sanja Denki Seisakusho K.K.), | 27 |
| A | 25 July, 1995 (25. 07. 95), Column 1, lines 2 to 9 ; Fig. 1 (Family: none) | 28-30 |

国際調査報告

国際出願番号　PCT／JP99／00163

A.　発明の属する分野の分類（国際特許分類（IPC））

Int. Cl⁶　B22D1／00, 17／30, C22C1／02

B.　調査を行った分野

調査を行った最小限資料（国際特許分類（IPC））

Int. Cl⁶　B22D1／00, 17／30, C22C1／02, C22B9／02, F27B14／10

最小限資料以外の資料で調査を行った分野に含まれるもの

| | |
|---|---|
| 日本国実用新案公報 | 1926－1996年 |
| 日本国公開実用新案公報 | 1971－1999年 |
| 日本国登録実用新案公報 | 1994－1999年 |
| 日本国実用新案登録公報 | 1996－1999年 |

国際調査で使用した電子データベース（データベースの名称、調査に使用した用語）

C.　関連すると認められる文献

| 引用文献のカテゴリー＊ | 引用文献名　及び一部の箇所が関連するときは、その関連する箇所の表示 | 関連する請求の範囲の番号 |
|---|---|---|
| Y<br>A | JP, 3－162533, A（古河電気工業株式会社）, 12. 7月. 1991（12. 07. 91）, 第1頁左欄第5行－第14行, 第2頁左下欄第3行－右下欄第13行, 第1図（ファミリーなし） | 1, 2, 5－16, 19, 20, 27<br>3, 4, 17, 18, 21－26, 28－30 |

☒ C欄の続きにも文献が列挙されている。　☐ パテントファミリーに関する別紙を参照。

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「A」特に関連のある文献ではなく、一般的技術水準を示すもの

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「&」同一パテントファミリー文献

| | |
|---|---|
| 国際調査を完了した日<br>10. 03. 99 | 国際調査報告の発送日<br>23.03.99 |
| 国際調査機関の名称及びあて先<br>日本国特許庁（ISA／JP）<br>郵便番号100－8915<br>東京都千代田区霞が関三丁目4番3号 | 特許庁審査官（権限のある職員）<br>後藤政博　印　4K　8926<br>電話番号　03－3581－1101　内線　3436 |

様式PCT／ISA／210（第2ページ）（1998年7月）

国際調査報告

国際出願番号　PCT／JP99／00163

C（続き）．　関連すると認められる文献

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|---|---|---|
| Y<br><br><br>A | JP，2－290931，A（鈴木自動車工業株式会社），<br>30．11月．1990（30．11．90），<br>第2頁右上欄第8行－右下欄第7行，第2図（ファミリーなし） | 1，2，5－16，19，20，27<br>3，4，17，18，21－26 |
| Y | JP，62－130234，A（工業技術院長），<br>12．6月．1987（12．06．87），<br>第3頁左上欄第6行－第12行，第1図（ファミリーなし） | 5，6<br>10，15 |
| Y | JP，7－223047，A（日立電線株式会社），<br>22．8月．1995（22．08．95），<br>第1欄第2行－第10行，図1（ファミリーなし） | 2，<br>11－14 |
| Y<br><br>A | JP，4－88135，A（株式会社レオテック），<br>23．3月．1992（23．03．92），<br>第2頁左下欄第6行－右下欄第14行，第1－3図<br>（ファミリーなし） | 8，16，<br>19<br>18 |
| Y<br>A | JP，7－185778，A（株式会社三社電機製作所），<br>25．7月．1995（25．07．95），<br>第1欄第2行－第9行，図1（ファミリーなし） | 27<br>28－30 |